BG3.11 Forest under pressure: the need to understand causes and mechanisms related to forest vulnerability and dieback phenomena

Differential climate memory drives tree growth in ongoing forest dieback

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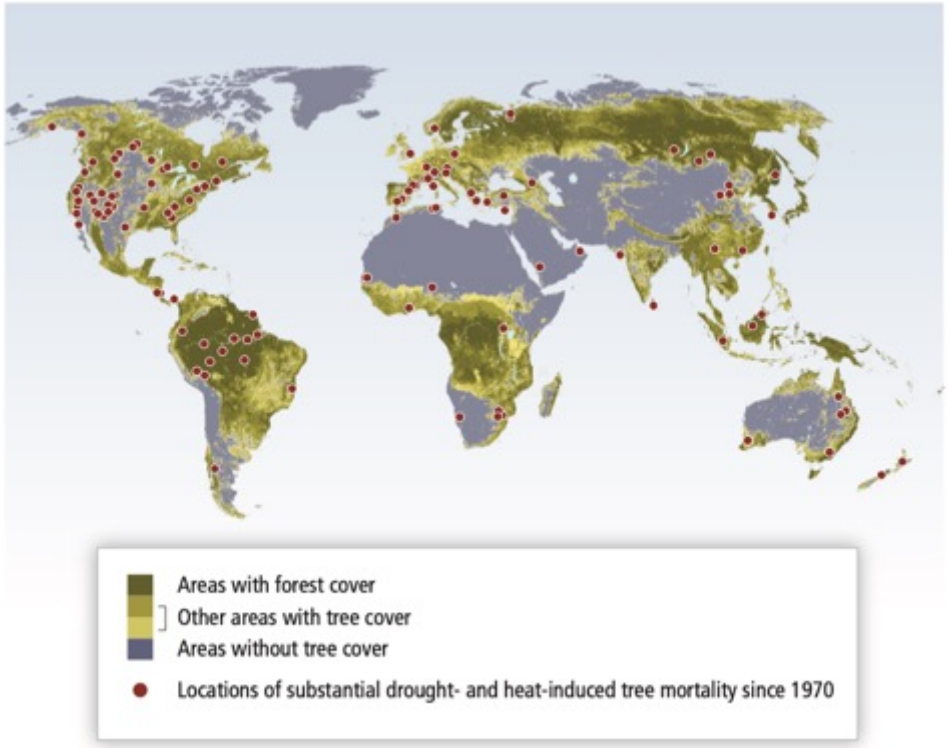
I. INTRODUCTION

Ecological memory

Drought- and heat-induced tree mortality and forest dieback

(Allen et al 2010, 2015)



Past climate conditions are critical determinants of tree growth and may predispose trees to mortality

(Anderegg et al. 2015, Peltier et al. 2018, Zweifel et al. 2020)

I. INTRODUCTION

OBJECTIVE

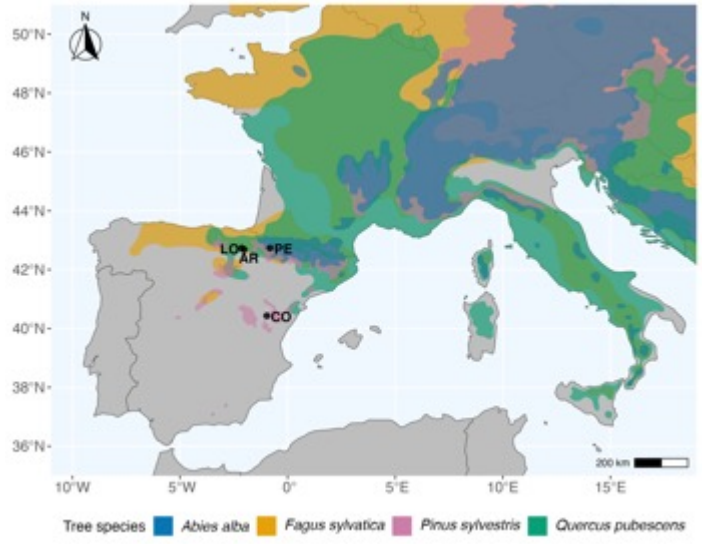
To determine whether the **climate memory of tree growth** differs in co-occurring trees of different **vigor classes** (declining and non-declining).

HYPOTHESES

- Declining trees have **lower growth rates** than non-declining trees.
- Declining trees are more **negatively** impacted by **warmer-drier** conditions.
- Declining trees are particularly affected by **more recent climate** conditions.

II. METHODS

Tree Ring Width (TRW)

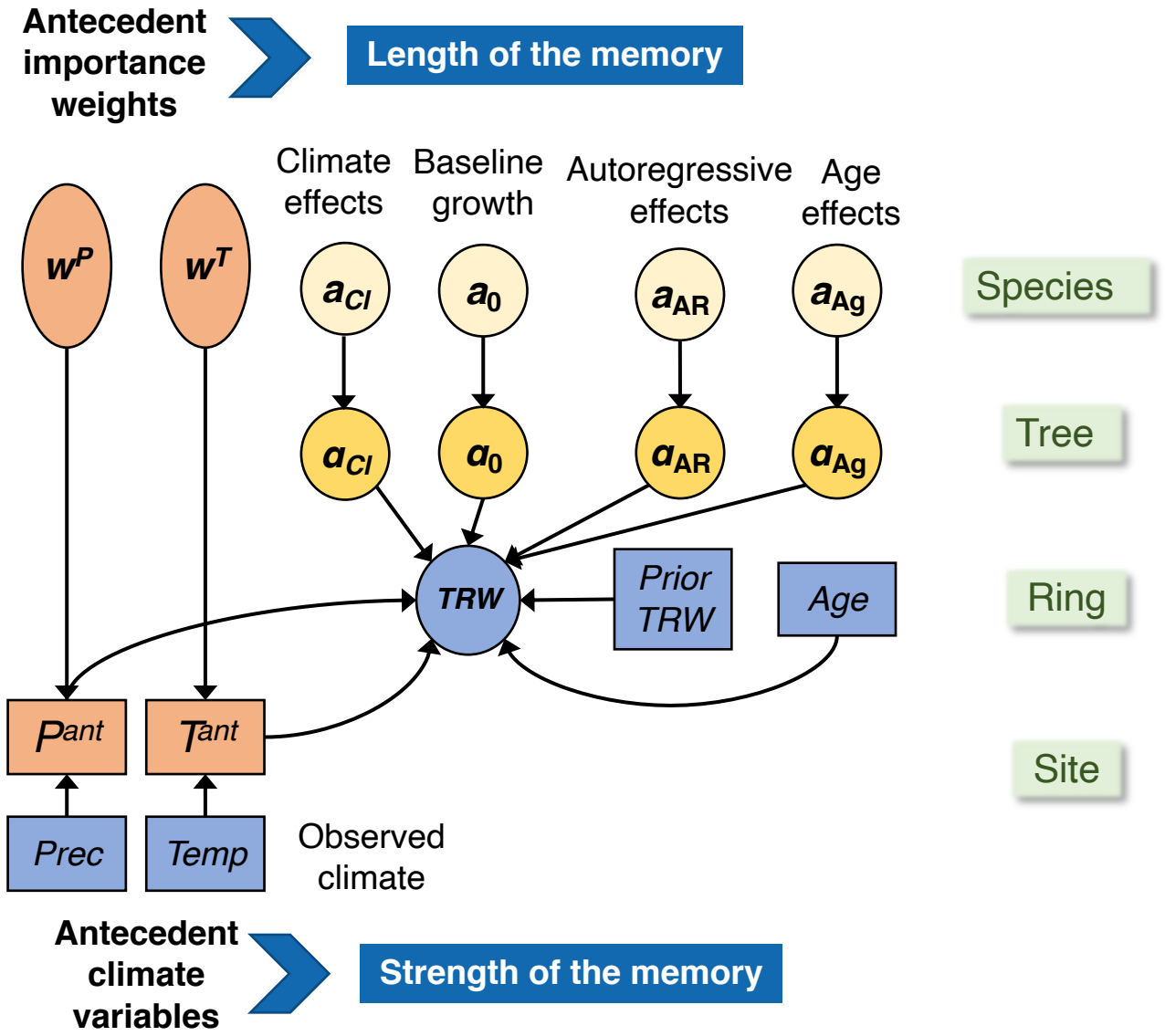


Vigor classes:

- Non-declining trees < 50% crown defoliation
- Declining trees ≥ 50% crown defoliation

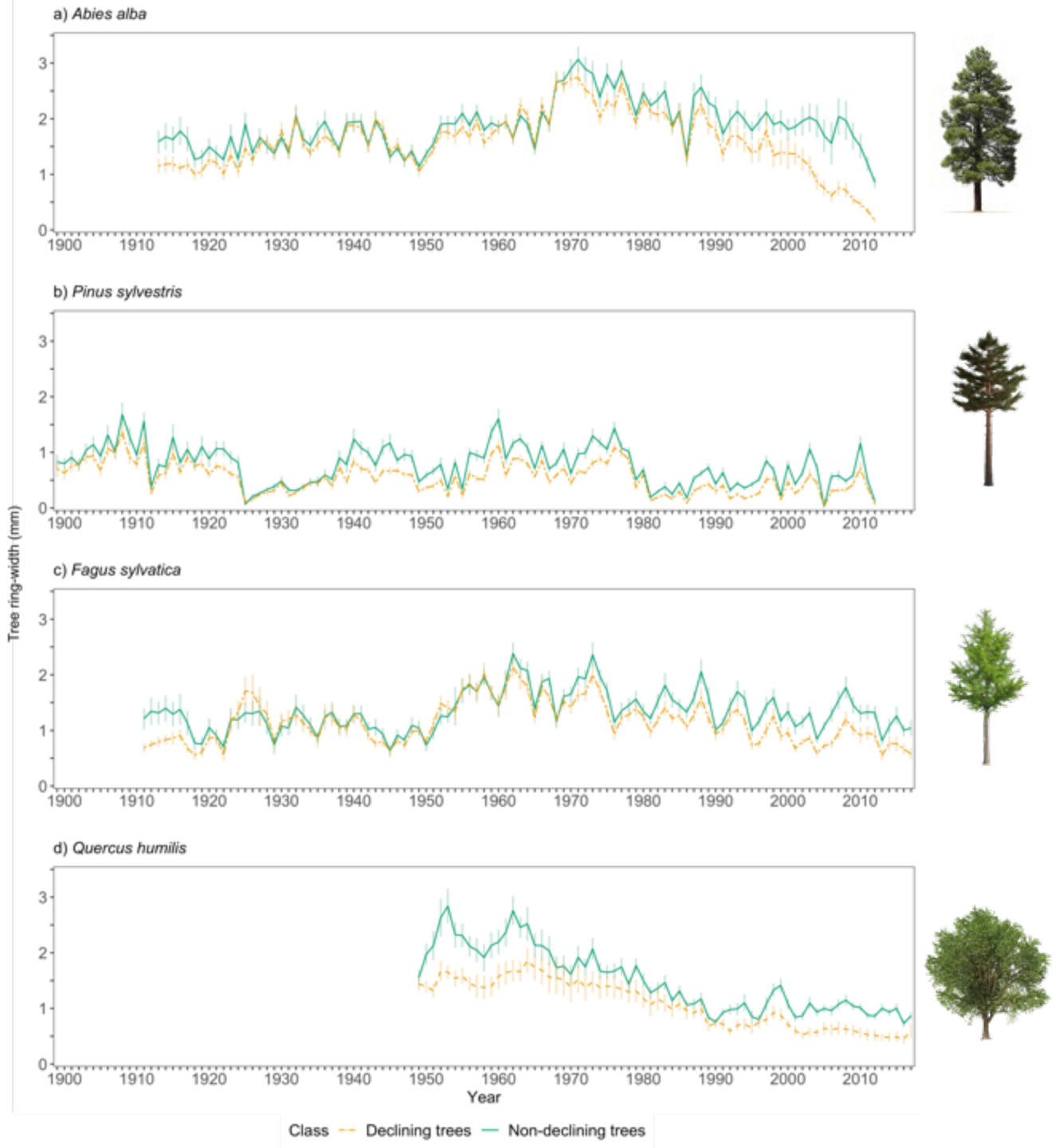
Stochastic Antecedent Modelling (SAM)

Ogle et al. (2015) *Ecology Letters*



III. RESULTS

Declining trees showed lower growth rates than non-declining trees.

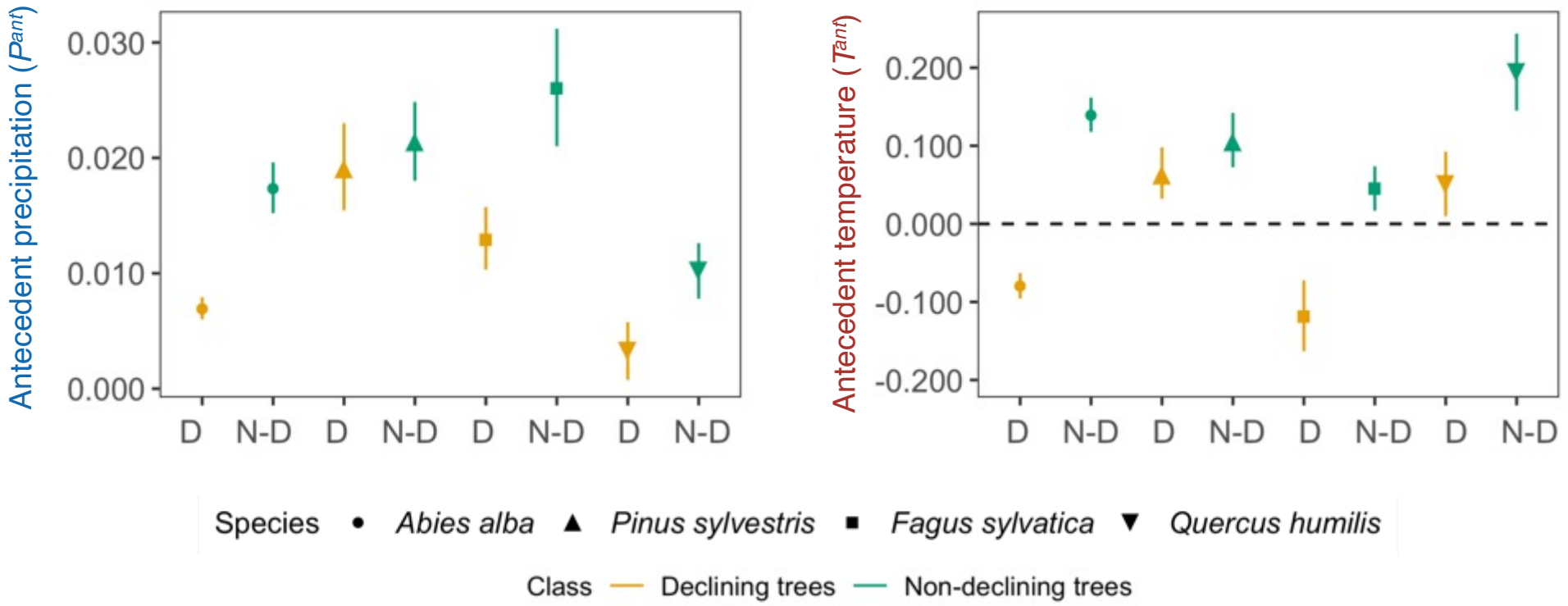


III. RESULTS

Antecedent climate variables: Strength of the memory

Effects of **antecedent precipitation (P^{ant})** were significantly **positive** for all species and vigor classes.

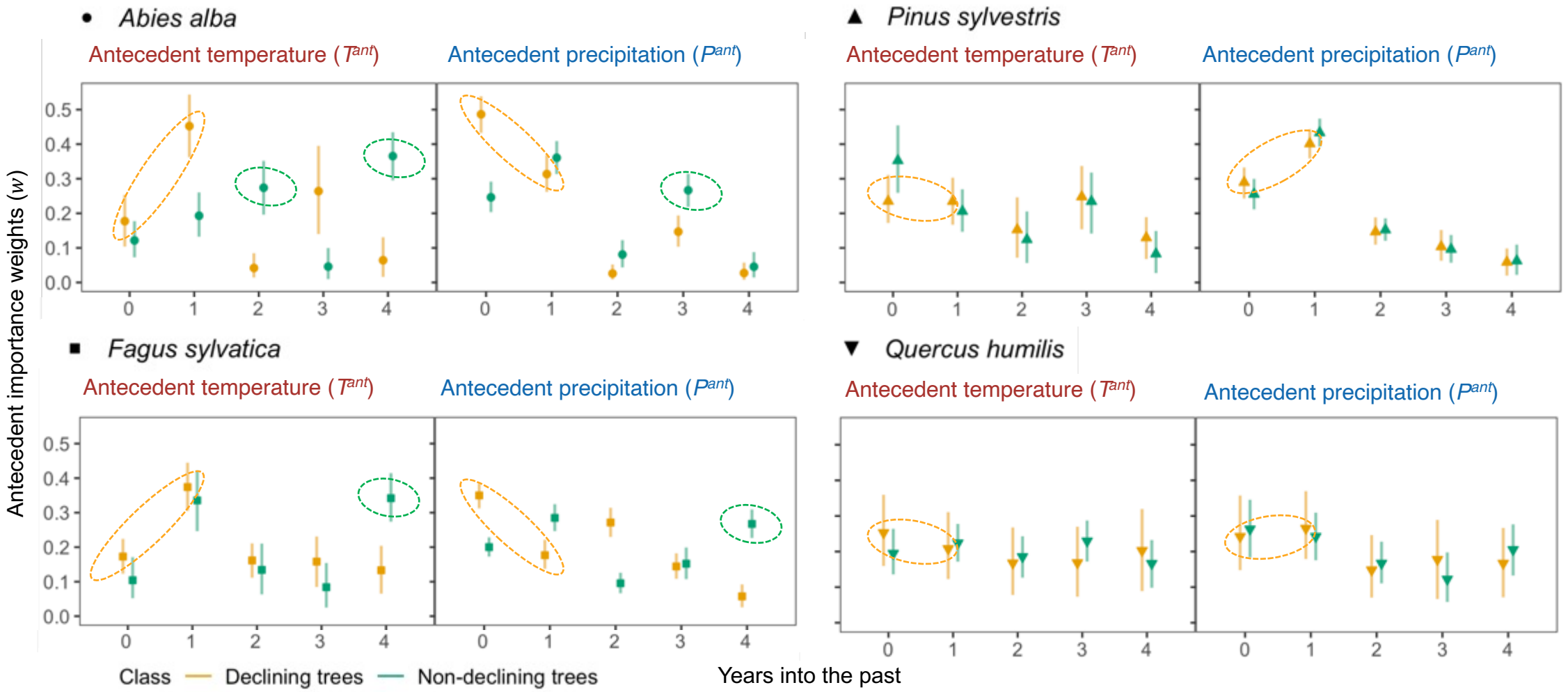
Effects of **antecedent temperature (T^{ant})** were significantly **positive** for most species and classes, but **negative** for declining fir and beech.



III. RESULTS

Antecedent importance weights: Length of the memory

- **Current and previous year** temperature and precipitation were important for **declining trees**.
- Climate conditions **further into the past** were important for **non-declining fir and beech trees**.



IV. CONCLUSIONS

- Our results highlight the **differences** in **climate sensitivity and memory** in forests experiencing ongoing dieback.
- Declining trees have **lower growth rates** than non-declining trees.
- Declining trees are more **negatively** impacted by **warmer** conditions.
- Declining trees have **shorter climate memory**, particularly for silver fir and European beech.

THANKS!

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EGU abstract

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